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DRAWINGS ATTACHED

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(54) IMPROVEMENTS IN SANITARY PRODUCTS

(71) We, CELANESE CORPORATION, of 522 Fifth Avenue, New York 36, State of New York, United States of America, a company incorporated in accordance with the laws of the State of Delaware, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a laminar structure useful as or for making sanitary napkins, diapers, bandages and other articles for absorbing liquid body discharges.

Because of the cost and unpleasant nature of the task of cleaning diapers various types of disposable diapers intended to be discarded after use have been put on the market. There are also other articles, e.g. sanitary napkins and tampons, used for absorbing liquid body discharges which are discarded after a single use. The ready disposal of all such articles presents a problem for which the present invention provides an acceptable solution by providing articles of the type referred to which can be disposed of in the domestic toilet bowl and flushed away without danger of causing clogging of the waste pipes of the sewage system. One such disposable article or material which is described in our Specification No. 1,217,452 comprises an absorbent water dispersible fibrous pad covered on at least one side with a liquid permeable bonded fibre covering comprising biodegradable fibres held together by a water insoluble organic polymer which is non-irritating to the human body, stable when in contact with such a body discharge and has a D value (as hereinafter defined) no greater than 5, a one inch wide strip of said covering being able to sustain a pull of at least 2.0 pounds when dry and a pull of at least 0.25 pounds when wet and capable of elongation without rupture by from 3 to 50% of its length whether wet or dry.

The laminar structure of the present invention comprises an absorbent non-woven web of cellulose fibres, a moisture-permeable layer of aligned staple fibres attached to and covering one surface of said web and a moisture-impermeable film attached to and covering the other surface of said web, said structure having channels in the face comprising the layer of aligned staple fibres, which channels extend into said web, run across the direction in which the staple fibres are aligned and are spaced apart by less than the average length of the staple fibres each of which is thus distorted by at least one of the channels, the bottom of each channel containing a thermoplastic resin which permeates adjacent cellulose fibres of said non-woven web, and thereby attaches the layer of aligned staple fibres to said web, and which is insoluble in water at the pH of the liquid body discharge to be absorbed but soluble in water a higher or at lower pH values.

By means of the invention there can be obtained laminar structures useful as or for making sanitary napkins, diapers, bandages, dress shields and other absorbent articles of personal hygiene which have sufficient wet and dry strengths to sustain pinning or other methods of fastening while being flexible, soft, non-irritating and capable of readily absorbing liquid body discharges without loss of their structural integrity and yet easily disposed of in a domestic toilet after disintegration by the action of dilute acid or alkali according to the nature of the thermoplastic resin present in the structures.

The fibres comprised in the moisture-permeable layer of aligned staple fibres may, in general, have an average length of between ½

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and 3 inches and, preferably, have an average length of 1 to 2 inches. With fibres less than ½ long it is difficult to achieve satisfactory intermittent bonding together by the resin in the channels while fibres longer than 3 inches tend to entangle so that the structure is liable to retain its integrity under conditions intended to destroy it. The fibres themselves may consist of, for instance, rayon, cotton or cellulose acetate or mixtures of fibres of these materials may be used. The layer of aligned staple fibres may be made, for instance, by carding and drafting a body of the staple fibres and may be treated with a resin, before use in making the laminar structure of the invention, to secure temporary cohesion of the fibres so that their alignment is maintained during the processing; resin used in this way can be water soluble or have the same solubility characteristics as that to be used in the channels in the laminar structure but must not be of such a nature or quantity as to destroy the permeability of the layer of aligned staple fibres when it forms part of the laminar structure.

The absorbent non-woven web may consist of any desired cellulose fibres, e.g. wood pulp of moderate alpha cellulose content or cotton linters, and may be formed, for instance, by carding, garnetting or by dry deposition from an air suspension of the fibres. Suitable webs can be conveniently produced, for example, by means of a Rando-Webber Machine (Curlator Company, Rochester, N.Y.) which gives webs having equal strength in all directions without the necessity of cross-laminating. The thickness of the web depends merely on the intended end use, i.e. the quantity of liquid which the product is likely to be called upon to absorb.

In making the laminar structure the layer of aligned staple fibres may be passed, together with a backing of the absorbent non-woven web through cameo or intaglio printing rollers wetted with a solution or emulsion of the thermoplastic resin used as binder and then dried. Cameo and intaglio printing are well known operations, the use of which involves passing the assembly through the nip between a pressure roller and a printing roller which has projecting or recessed binder-applying portions, respectively, which are spaced according to the desired design. When employing cameo printing the projecting ridges should be cupped or recessed so as to pinch or locally compact the web in order to diminish the tendency for the binder to spread or diffuse beyond the pinched or locally compacted web portions. The printing roller can be wetted by the resin solution or emulsion in any of various conventional manners such as by a furnish roller or a doctor blade. In a preferred embodiment, a resin solution is sufficiently diluted with a volatile organic solvent, e.g. methyl ethyl ketone, to reduce its viscosity and thereby increase its penetration. After printing, part of the solution is evaporated, e.g. in an oven, to render the resin solution tacky. The structure can then be compacted. The printed design remains indented below the surface of the unprinted portions thus forming the required channels. The compression of the web along the printed lines also provides added reinforcement for the web.

In a simple embodiment of the invention, the printed lines, i.e. the resin-containing channels, can be parallel to each other and perpendicular to the direction of the aligned fibres to provide lateral strength. Also a criss-crossing pattern can be employed to give reinforcement in both directions. The optimum total surface area which the resin pattern should cover can be determined by simple experimentation as a function of the nature of the fibre and the intended end use. If the area which the resin covers is too high, moisture-permeability is significantly reduced. On the other hand, if the area the resin covers is too low, the structure will not have the requisite dry and/or wet strength.

The backing film must be impermeable to the body fluids that the structure is required to absorb. In a preferred embodiment this film exhibits selective solubility properties similar to those of the thermoplastic resin used as binder, i.e. it is water insoluble in the pH range of the body fluids that it will be in contact with and water soluble at pH values above or below this range. For this purpose, the film can be cast from resin employed as the binder for the covering web and the backing film can be adhered to non-woven web forming the inner layer by the same resin. If desired, the resin-containing channels employed in binding the covering moisture-permeable layer to the absorbent non-woven web can also serve to bind the backing layer to the non-woven web. For this purpose the resin design should be deeply printed. The depth of printing can be controlled by the roller design, the viscosity of the resin solution, the pressure and the web construction.

The channelled resin pattern of the structures of this invention serves several important functions in addition to strengthening the covering web. First of all it anchors the non-woven web to the moisture-permeable layer and prevents any tendency during handling and use for the cellulose fibres in the web to break up and shift in position. Such shifting of the fibres would cause lumps in one area and relatively empty areas of reduced absorptive capacity. Secondly, it provides channels to conduct the liquid discharge away from its area of deposition. This increases both the total effective absorbency of the structure and the rate of absorption. This prevents any tendency for puddle formation

or leakage from the edges of, for instance, diaper made from the structure. Thirdly, since the resin is below the surface of the covering it does not impart any actual irritation. Fourthly, the resin can be quickly solubilized since the solubilizing solution immediately comes into contact with the resin without having to permeate any covering material. Moreover the channelling increases the flexibility of the structure and provides a pleasing design.

Preferred embodiment of the invention are further illustrated in the accompanying drawings, in which:

Fig. 1 is a schematic view of apparatus for the production of a preferred structural embodiment:

Fig. 2 is a fragmentary perspective view of the cameo printing roller shown in Fig. 1:

Fig. 3 is a fragmentary top plan view of the product:

Fig. 4 is a fragmentary sectional view taken along line 4—4 of Fig. 3.

In using the apparatus shown in Figure 1, an upper layer of aligned staple fibers is joined with a lower layer 2 of a non-woven web of cellulose fibres which is fed around guide roller 3 to the nip between rollers 4 and 6. Roller 4 is a cameo printing roller having projections 5 jutting out therefrom in a regularly spaced pattern. These projections, before engaging the layers in the nip, intermesh with the rubbery exterior 8 of furnish roller 7. This rubbery exterior is inked by conventional means (e.g. reservoir 21) with a solution 9 of the selectively soluble thermoplastic resin. Thus, the projections 5 after leaving 8 carry resin solution 9 thereon. As the rotating projections compress layers 1 and 2 against backing roller 6, the resin solution is deposited on layer 1 and proceeds to some depth into layer 2. The printed layers 1 and 2 then proceed by conveyor belt or other suitable means through a heating zone such as oven 10 to remove some of the solvent from the resin solution and thus render it tacky. After leaving the heated zone the printed layers are then passed through the nip between rollers 11 and 12 which compress these layers. At the same time a film layer 15 coming from supply roll 13 and around guide roller 14 and pressure roller 12 is laminated to the undersurface of layer 2. Layer 15 is sprayed with a fine mist of resin solution 19 by conventional means 17 at a point between rollers 14 and 12. The resulting product 16 after drying contains permanent channels in the desired pattern.

The surface of the printing roller 4 can be more clearly seen in Fig. 2. The roller, containing ridges 5 in the form of a diamond pattern illustrates one form of applicator that may be used. As noted above, these ridges contain recesses 20 to minimize lateral migration of the resin solution. The final product 16 has a channelled surface as shown in Fig. 3. This pattern corresponds to the pattern in Fig. 2. The channels 18 are more clearly visible in cross-section in Fig. 4. These channels distort the fibres of layer 1 and extend well into the non-woven web 2. The resin 9 serves not only to bond the fibres in layer 1 together but to anchor layer 1 to the web 2. When liquid is discharged at a point on the surface of layer 1, it can be rapidly conducted away along the channels 18 to dry areas of web 2 thus making fuller use of the absorbency of web 2 and preventing puddle formation at the area of discharge. As can further be seen from Fig. 4, the channels 18 also increase the effective surface area of the web through which the liquid can be absorbed.

The selectively soluble thermoplastic resin used can be acid-or alkali-soluble, the choice of course being subject to the nature of the intended end use. For example, a structure of this invention intended as a dipper should contain an alkali-soluble resin rather than an acid-soluble resin in view of the acidity of urine (the pH of human biological materials is broadly within the range of 4.6 to 8.4 with blood being in the range of 7.3 to 7.5).

The resin should not be one that irreversibly cross-links under the conditions of production, storage or use.

Numerous polymer systems which are insoluble in neutral or acidic media but which are soluble in alkaline media can be used, for example, copolymers of acrylic or methacrylic acid with an alkyl methacrylate, e.g. methyl methacrylate, such as a copolymer of 80% by weight of ethyl acrylate and 20% by weight of methacrylic acid, polymeric carboxy ester lactones, styrene-monoethyl maleate heteropolymers and poly-N,N′ -diethylacrylamide. Similarly, polymer systems can be used which are insoluble in neutral or alkaline media but which are soluble in acidic media, for example, copolymers of aminoacrylates such as dimethylaminomethacrylate and an alkyl acrylate such as ethyl acrylate. It is of course possible with practically all polymeric systems to employ ratios of comonomers such that the resultant poymer is insoluble at virtually any pH and the conditions of polymerization of these monomers and comonomers should be regulated so that the resultant polymer will have the desired solubility properties.

Chemically diverse solubilizing moieties can be utilized in the resins required for the products of this invention. Selectively alkali-soluble resins may contain such functional groups as carboxylic acids, sulphonic acids, sulphites, sulphates, phenolic hydroxyl groups, esters and damides. Selectively acid-soluble resins may contain such functional groups as amines, esters, amides and nitriles. It is not

necessary that the acidity or basicity be "free" but it is critical that in alkaline or acidic solution, respectively, they react to solubilize the polymer.

The structures of this invention can be cut into the shape and size that the end use requires. The nature of the structure and its method of production permits a continuous cutting operation. If desired, the structure can be heat compressed to give a smooth-edged product and this will help prevent leakage from the edges.

The products of this invention can be disposed of simply by placing in the toilet, adding a neutralizing agent and flushing. When an acidic thermoplastic resinous binder is used, materials which can be conveniently employed to render the toilet water sufficiently alkaline include ammonia, sodium carbonate, sodium and ammonium borate and sodium hypochlorite. When a basic thermoplastic resinous binder is used, materials such as citric acid, acetic acid, tannic acid, boric acid, and acid salts such as calcium and aluminum chloride can be used to render the toilet water sufficiently acidic.

If the backing film is not composed of a material which is solubilized by the neutralizing agent, it can be peeled off and disposed of with other household refuse.

No shredding or special toilet attachments are necessary in order to flush the sanitary products of this invention. Enough dispersion is achieved within a few moments after addition of the acidic or basic material to render these sanitary products flushable without danger to the plumbing system. The rate of dispersion is of course a function of the neutralizing power of the added material.

Compatible additives can be incorporated into the structure to impart desired properties, e.g., bacteriostatic, deodorant, and dye additives.

WHAT WE CLAIM IS:—

1. A laminar structure useful as or for making articles for absorbing liquid body discharges which comprises an absorbent non-woven web of cellulose fibres, a moisture-permeable layer of aligned staple fibres attached to and covering one surface of said web and a moisture-impermeable film attached to and covering the other surface of said web, said structure having channels in the face comprising the layer of aligned staple fibres, which channels extend into said web, run across the direction in which the staple fibres are aligned and are spaced apart by less than the average length of the staple fibres each of which is thus distorted by at least one of the channels, the bottom of each channel containing a thermoplastic resin which permeates adjacent cellulose fibres of said non-woven web, and thereby attaches the layer of aligned staple fibres to said web, and which is insoluble in water at the pH of the liquid body discharge to be absorbed but soluble in water at higher or at lower pH values.

2. A laminar structure according to Claim 1, wherein said aligned staple fibres have an average length of from 1 to 2 inches.

3. A laminar structure according to Claim 1 and substantially as hereinbefore described.

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1236904 COMPLETE SPECIFICATION
1 SHEET *This drawing is a reproduction of the Original on a reduced scale*

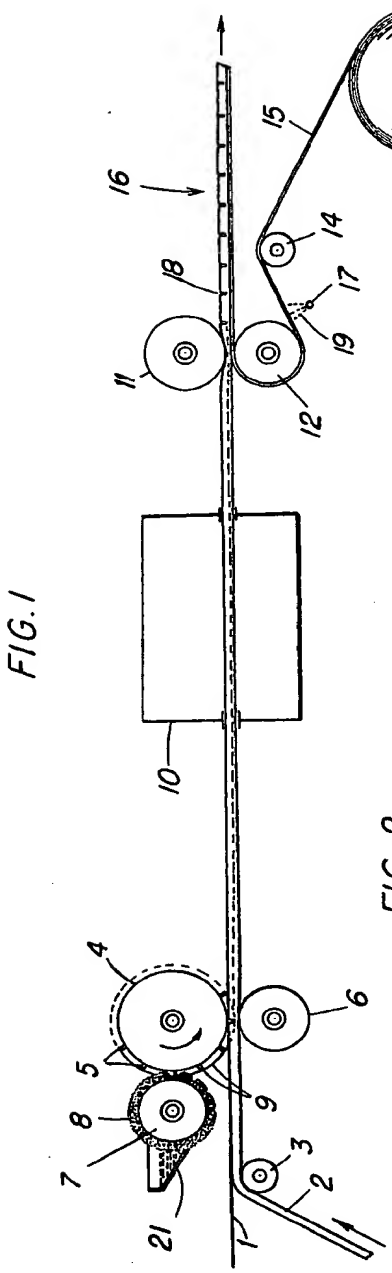

FIG. 1

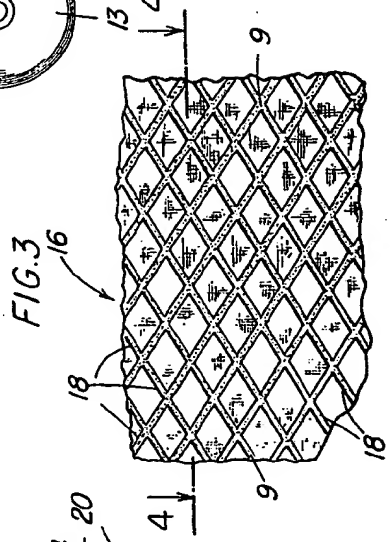

FIG. 3

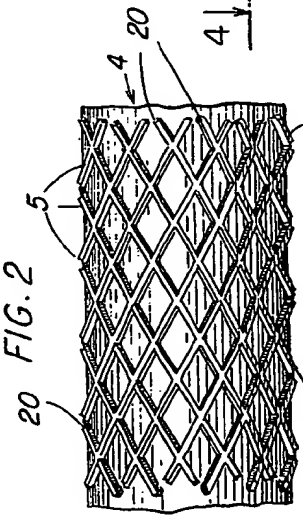

FIG. 2

FIG. 4